Calgon Carbon Corporation Information

CALGON

CALGON CARBON CORPORATION

111 Anza Blvd., Suite 412, Burlingame, CA 94010

Attention: Gerhard PANUSCHKA
Date: 3.6.95
Company: URS
Phone: 916-929-2346
From: DAVE JORDAN
Fax #: 916 929-7263
Subject: San Bernardino Co
No. Of Pages: 1

Comments:

Gerhard-

The carbon usage rates, when operating @ 700gpm per vessel (on pairs of vessels for series operation are as follows

SERIES : 0.055 lb/1000 gallons
PARALLEL: 0.061 lb/1000 gallons

These are based upon breakthru of TCE - which is the leading compound to breakthrough - base upon, Dow MCL, Methylene Chloride, Chloroethane Freon 11 and Freon 12 breakthru before TCE but are not regulated, Cis 1,2-DE PCE and Toluene breakthrough after TCE.

Based upon these results you will utilize approximately 10% 10% more GAC by operating in parallel instead of series -

Regards, Dave

PLEASE CALL IF YOU DO NOT RECEIVE THE TOTAL NUMBER OF PAGES

Phone # (415) 548-2040 FAX # (415) 344-2029

URS CONSULTANTS, INC

☐ MEMORANDUM ☐ CONFERENCE NOTES ☒ TELCON REPORT

TO: Steve Wood/Rae Winter & Dave Jordan
CALGON Carbon Carlsbad

DATE: 11-7-94, 11:00
415-572-9111
Fax: 619-431-8169

FROM: _____

SUBJECT: LPGAC @ Newmark North

PROJ. NO.: _____

Left voice mail

11-8, 8:45 —u—

9:10 Dave Jordan will take care of it; I now fax it to Rae and she'll forward it to Dave Jordan who is the expert on this application.

Told her I needed to compare costs of an ECS for the air strippers against LPGAC system.

14:55 Freon: may be a problem; will need a few days to run data → Thu. or Fri. Told him I want it ASAP.

11-10, 8:35 Dave isn't in this morning → left message

14:40 0.05 lbs GAC/1000 gal — LPGAC @ ~ $1/lb (virgin) — $13,140,000/yr
232 lbs/day — VPGAC (50% RM) @ ~ $2/lb — 84,680 lbs/yr

Not much competition, but loading anyways; Freon is a problem.

DCE: 0.025 lbs GAC/1000 gal
Freon 11: 2 lbs/1000 gal
Freon 12: 1.5 lbs/1000 gal
PCE: 0.02 lbs/1000 gal

} LPGAC — don't add in trivials — He modeled by competitive adsorption

~~460~~ lbs LPGAC/d ⇒ ~~75,000~~ 150,000 lbs/yr for PCE/TCE/DCE
20 lbs VPGAC/d — 40,000 lbs/yr — " —

8 in parallel or 16 for series op.; can sample on side of vessel

2 - 12'0" dual @ 20,000 each + heating.

x4 $184,000/pair

$100,000 x2

DISTRIBUTION: _____ Page _____ of _____

URS #114 3/92

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CALGON CARBON CORPORATION

MODEL 10 ADSORPTION SYSTEM

ACTIVATED CARBON PRODUCT BULLETIN

DESCRIPTION

The Calgon Model 10 Adsorption System has been designed for the removal of soluble organic chemical contaminants from water or wastewater using granular activated carbon products. The system is particularly suitable for applications with low levels of organic contaminants or with flow rates up to 700 gallons per minute per vessel.

The Model 10 unit is a complete water treatment system, skid mounted for ease of installation, and is provided with piping for series or parallel operation. The skid feature allows rapid installation because only the steel skid must be attached to a foundation, while the adsorption vessels and piping are then attached to their proper location on the steel framework.

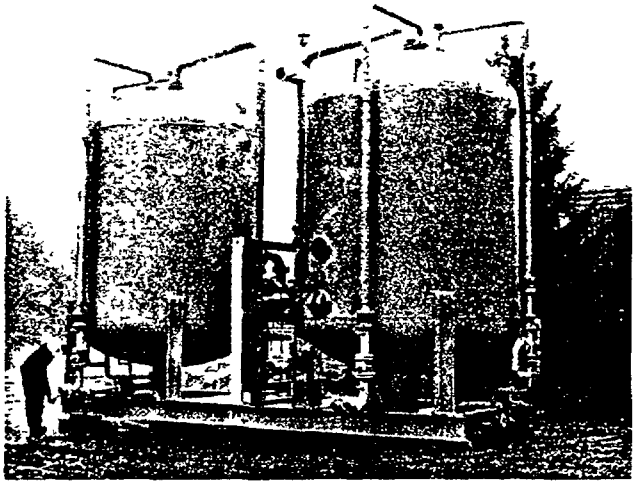
The Model 10 system is provided with pre-assembled piping sections for influent and treated water, utility water and compressed air, carbon transfer and venting operations. Water and utility piping need only be brought to the Model 10 and connected to complete the installation of the treatment process.

The Model 10 adsorber vessels are ASME coded for 75 psig, lined for corrosion resistance and are designed to contain 20,000 lbs of Calgon Carbon's granular activated carbon. Carbon transfer piping allows use of Calgon Carbon's convenient carbon service including special transfer trailers. At a flow rate of 350 gpm, each adsorber provides 15 minutes contact time.

Your Calgon Carbon Technical Sales Representative can help you evaluate the suitability of the Model 10 to satisfy your requirements. If needed, adsorption evaluation tests or studies to determine applicability and economics can be arranged. Calgon Carbon offers adsorption equipment in many other sizes, and carbon supply and exchange services to meet your particular needs.

FEATURES

- Proven design—downflow fixed bed adsorption.
- Pre-engineered package—simple and quick installation.
- ASME code vessels compatible with Calgon Carbon Service.
- Vinyl Ester Resin lined vessels suitable for potable water.
- Pipe sizes are designed for the flow rate desired.
- Distributor underdrain for even distribution.
- Manway for maintenance access.
- Backwash capability can be added if suspended solids are present.
- Designed to minimize operating labor and avoid manual handling of carbon.
- Designed for complete removal of exhausted carbon to minimize problems with contaminated material remaining in vessel.
- Capable of bulk carbon filling and removal.
- Granular activated carbon fill and discharge piping.



AVAILABLE AUXILIARY SERVICES

- Calgon Carbon Service

OPTIONAL OPERATION MODES

- Downflow fixed bed or
  Downflow fixed bed with backwash capability.
- Series or Parallel flow.

SPECIFICATIONS

Vessel Diameter:	10 ft
ASME Code:	Design 75 PSIG @ 150° F (higher pressure vessel ratings available)
Pipe Connections:	Process pipe: Sized per flow rate; flange connection std. Water pipe: 1-1/2-inch flange
Carbon Volume per Vessel:	715 cu.ft. (nominal 20,000 lbs-granular activated carbon)
Weight:	Empty—38,000 lbs.; Operating—230,000 lbs.
Pressure Relief:	72 PSIG nominal setting
Backwash Rate:	1000 GPM (if required)
Transfer Mode:	Air pressurized slurry transfer

TYPICAL FLOW RATES AND CONTACT TIME

Series Operation		Parallel Operation	
GPM	Contact Time Minutes	GPM	Contact Time Minutes
350	30	700	15

NOTE: Smaller Calgon Carbon Service Systems are available for smaller flow rates and lower carbon usage applications.

MATERIALS OF CONSTRUCTION AND AVAILABLE OPTIONS

- Vessel Lining: Vinyl Ester coating (nominal 40 mil) suitable for potable water and most wastewater applications.
- Piping and Valves: Carbon steel piping and cast iron butterfly valves (process) and stainless steel ball valves (carbon transfer).
- Optional flanged polypropylene lined piping with diaphram valves for process water.
- Underdrain Collection System: Polypropylene slotted nozzles.
- External Coating: Epoxy Mastic Coating
- Optional polyurethane coating system for more corrosive environments.

CAUTION

Wet activated carbon preferentially removes oxygen from the air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable Federal and State requirements.

For information regarding human and environmental exposure, call (412) 787-6700 and request to speak to Regulatory and Trade Affairs.

Calgon Carbon Corporation reserves the right to change specifications without notice for components of equal quality.

For additional information, contact Calgon Carbon Corporation, Box 717, Pittsburgh, PA 15230-0717 Phone (412) 787-6700

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Printed in U.S.A.

CALGON CARBON CORPORATION

FILTRASORB® 300 and 400 GRANULAR ACTIVATED CARBONS FOR POTABLE WATER TREATMENT

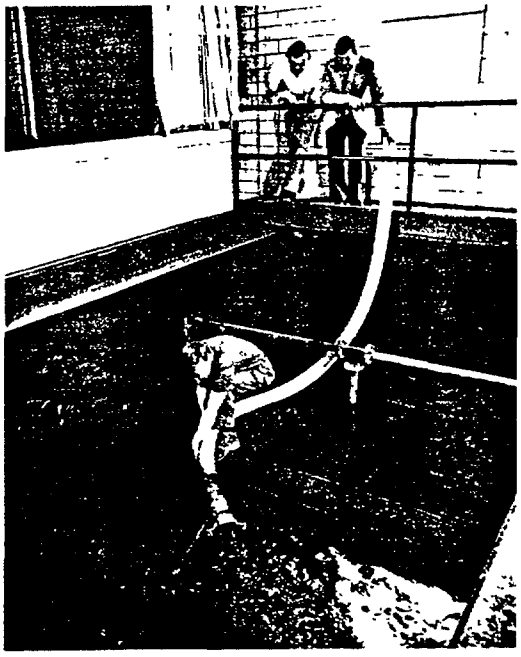
ACTIVATED CARBON PRODUCT BULLETIN

TWO GRADES OF HIGH-ACTIVITY GRANULAR ACTIVATED CARBON WHICH PROVIDE THE MOST COST-EFFECTIVE REMOVAL OF TASTE, ODOR AND DISSOLVED ORGANIC COMPOUNDS FROM PUBLIC WATER SYSTEMS

DESCRIPTION

Filtrasorb 300 and Filtrasorb 400 are two high-activity granular activated carbons developed by Calgon Carbon Corporation for the removal of tastes, odors, and synthetic contaminants from public water supplies.

Both activated carbons are manufactured from select grades of bituminous coal to produce a high-activity, durable granular product capable of withstanding the abrasion associated with repeated backwashing, air scouring, and hydraulic transport. Activation is carefully controlled to produce exceptionally high internal surface area with optimum pore size for effective adsorption of a broad range of high and low molecular weight organic contaminants.



Hydraulic installation makes filling gravity filter beds with Filtrasorb granular activated carbon a simple and clean operation.

PURPOSE

Filtrasorb activated carbons can be used to upgrade water quality in existing sand filtation systems. Used as a complete replacement for sand or anthracite coal, Filtrasorb activated carbons function as a dual purpose medium, providing both filtration and adsorption. As a replacement for existing filter media, Filtrasorb activated carbon can be used as an adsorbent to complement normal filtration processes. In either case, conversion to Filtrasorb activated carbon imposes no major changes to a plant's normal filtration operations.

In situations where average flow volume is so high that complete replacement of existing media does not provide sufficient contact time with the activated carbon, Calgon Carbon Corporation can provide complete modular adsorption systems as an add-on treatment stage. These systems provide a rapid, effective and economical method of upgrading water quality to meet the 1986 Safe Drinking Water Act amendments (SDWA), or to solve taste and odor problems.

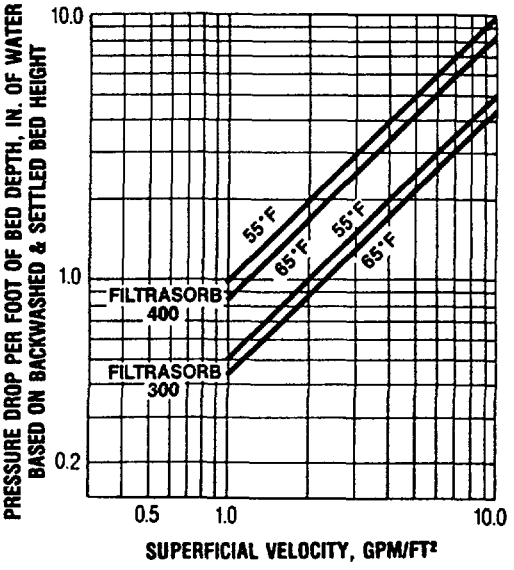
ADVANTAGES

- **Proven Reliabilty** —Years of experience in more than 150 public water supply systems have established granular activated carbon adsorption as the most reliable taste and odor removal process available.
- **Reserve Capacity** —The reserve capacity of granular activated carbon can effectively control sudden water quality fluctuations and unexpected contamination. There are no messy adjustments of powdered carbon feed systems or problems of undertreatment or wasteful overtreatment.
- **Low Cost** —In plants using 2-4 ppm powdered activated carbon feed on a year-round basis, granular activated carbon filter beds are more economical.
- **Easy to Use** —Installation of granular activated carbon is a simple and clean operation. In use, it needs no more handling than conventional sand filter media—no bags of dusty powdered activated carbon to handle every day.

SPECIFICATIONS

	FILTRASORB 300		FILTRASORB 400	
	Specification Value	*Typical Analysis*	*Specification Value*	*Typical Analysis*
U.S. Standard Series Sieve Size				
Larger than No. 8	Max. 15%	8%	—	—
Smaller than No. 30	Max. 4%	2%	—	—
Larger than No. 12	—	—	Max. 5%	1%
Smaller than No. 40	—	—	Max. 4%	2%
Iodine Number, min.	900	950	1000	1050
Abrasion Number, min.	75	80	75	78
Moisture (max.)	2.0%	0.8%	2.0%	0.9%

HEAD LOSS CHARACTERISTICS
PRESSURE DROP CURVES
FILTRASORB 300 AND FILTRASORB 400



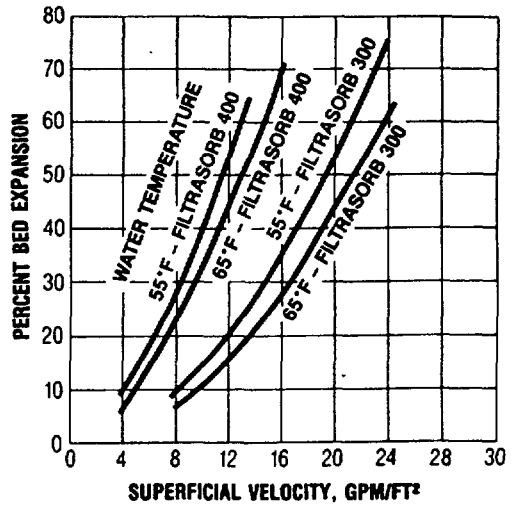
PHYSICAL PROPERTIES

	FILTRASORB 300	FILTRASORB 400
Total surface area (N_2, BET method) m^2/g*	900-1000	900-1100
Bulk density, lbs/ft^3**	28	27
Pore volume, cc/g*	0.75-0.85	0.85-0.95
Effective size, mm	0.8-1.0	0.55-0.75
Uniformity coefficient (max.)	2.1	1.9

***For general information and not to be used as purchase specifications.**

****Used to calculate volume requirements.**

FILTRASORB 300 AND FILTRASORB 400



PACKAGING

Filtrasorb activated carbon can be supplied in 55-lb net wt. multi-wall bags, 1000-lb net wt. super sacks, or shipped by bulk truck.

CAUTION

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including applicable federal and state requirements.

For additional information, contact Calgon Carbon Corporation,
P.O. Box 717, Pittsburgh, Pennsylvania 15230-0717
Phone (412) 787-6700

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CALGON CARBON MODULAR ADSORPTION SYSTEM
MODEL 10 X 8
(10 ft dia. adsorbers / 8 in dia. process pipe)

1. SCOPE OF WORK

The following specification describes all equipment, materials and services necessary to provide a complete pi engineered granular activated carbon adsorption system. system is designed to allow for two-stage or parallel operation for efficient carbon usage, backwashing of the carbon bed to remove filterable solids and ease and completeness of carbon exchanges.

The adsorption system is identified as Calgon Carbon Corporation's Modular Adsorption System - Model 10 X 8; v specifies two 10 foot diameter carbon adsorbers and 8 inc piping for the water or other liquid to be treated. The Modular Adsorption System is designed to be used with selected grades of Calgon Carbon's granular activated ca: (GAC), and is specially designed to accommodate the rei of the spent carbon and recharge with fresh carbon using Calgon Carbon's exchange service and transport equipment

Calgon Carbon Corporation will take complete responsibil: for the design, fabrication, delivery and installation o: adsorption system, including the initial fill of GAC. Up completion of installation, Calgon Carbon personnel will train site personnel in the operation of the adsorption system and provide Operating and Maintenance Manuals.

1.1 Adsorption System Design

The total adsorption system contains an installed capaci· 20,000 pounds of GAC in each of two adsorbers. Overall system design flow will be up to 700 gpm per adsorber, a total pressure drop of less than or equal to 20 psig wit two adsorbers operated in series. The system flow rate should be verified with the design contact time, determi by the volume of the carbon bed divided by the flow rate with the resultant contact time normally expressed in minutes. The system pressure drop is measured beginning the influent piping and ending with the effluent piping the system battery limits, based upon clean water and a c carbon bed. The system is designed to treat water in the pH range, or that is otherwise not corrosive to carbon s or cast iron material.

Battery limits for the adsorption system are defined as the influent, effluent, backwash and vent connection flar all hose connections and the support skid. All equipmen within these limits are provided by Calgon Carbon.

1.2 Work Included

The Scope of Work includes the furnishing of all equipment, materials and services to comprise a complete adsorption system:

1.2.1 Two 10 ft dia. downflow adsorbers including a water collection system (underdrain). Adsorbers are ASME code pressure vessels, with a corrosion resistant lining where GAC is in contact with the steel. Adsorbers include a cone design to facilitate complete removal of the spent GAC from the vessel.

1.2.2 Eight Inch dia. carbon steel pipe with cast iron fittings for influent, effluent and backwash piping on the adsorption system. Piping allows placement of either adsorber in the lead position in a series arrangement, or allows both adsorbers to be operated as a single stage or in parallel. Valving allows either adsorber to be isolated for carbon exchange or backwash, while maintaining operation through the other adsorber if viable.

1.2.3 Independent GAC fill and discharge piping, including corrosion resistant valves and hose connections.

1.2.4 Vent and pressure relief piping, flush water connections, motive air connections for GAC transfers, pressure gauges and sample points.

1.2.5 Delivery and installation of the Adsorption System. System may include an optional steel support skid.

1.2.6 Delivery and installation of 20,000 pounds of granular activated carbon, as specified, per adsorber.

1.2.7 One complete set of technical specifications and six Operation and Maintenance Manuals.

1.2.8 Training of site operators by qualified Calgon Carbon personnel.

1.3 Work Not Included

The following work is not included by this Scope of Work and is to be the responsibility of others:

1.3.1 Foundation design, foundation and anchor bolts

1.3.2 Influent or backwash water supply, effluent or backwash disposition, utility water or air supply, including regulation or monitoring of such flows.

1.3.3 Any winterization, including insulation, heat tracing or building.

1.4 Services Required

The following services are to be supplied to the adsorption system to provide for carbon transfers:

1.4.1 Compressed air to provide motive force for carbon transfers; supplied at 100 scfm at 30 psig for adsorbers and 15 psig for transport trailers.

1.4.2 Uncontaminated water to provide for slurry of fresh GAC; supplied at 100 gpm and 30 psig (minimum flow and pressure)

1.4.3 Uncontaminated water to provide for initial backwashing and classification of carbon bed; supplied to the adsorption system at 1000 gpm and 30 psig (minimum) for a minimum of 15 minutes per adsorber.

1.4.4 Drainage capability to allow for draining spent carbon of transfer (slurry) water prior to the transport trailer leaving the site. Transfer water will consist of approximately 4,000 gallons of slightly contaminated water.

1.4.5 Drainage capability for backwash water, after a fresh load of carbon is installed and when backwash is required. Backwash water typically amounts to 15,000 gallons per 1.4.3.

2. PROJECT SUBMITTALS

In order to assure that the Calgon Carbon Modular Adsorption System meets all the technical requirements of the site and treatment process, technical and design submittals will be provided at key points in the project. Any information provided by Calgon Carbon that is considered to be confidential, will be provided only after a confidentiality agreement is signed, and then will be clearly marked or designated.

2.1 Proposal Submittals

The following submittals will be made with the proposal;

2.1.1 Proposal Specification, including Scope of Work and general equipment or material specifications

2.1.2 Proposal Piping and Instrumentation Drawing indicating line sizes, valving, utility line sizes and all connections

2.1.3 Proposal Equipment Arrangement, including battery limit location, system dimensions and elevations, system weights and recommended foundation requirements.

2.1.4 Terms and Conditions for the Engineered System purchase

2.2 Contract Submittals

Two weeks after the receipt and acknowledgment of the purchase order by Calgon Carbon Corporation, the following submittal shall be made for approval. Any substantive changes from the Proposal Submittal as described in Section 2.1 may require a written change notice, a corresponding addendum to the purchase order pricing and adjustment of the system delivery date. All drawings and specifications will be updated, and issued as "as-built" documentation upon completion of the project, if necessary.

2.2.1 Piping and Instrumentation drawing; including all Calgon Carbon Specification notation for materials, valving, instrumentation and system accessories.

2.2.2 General Arrangement, Plans and Elevations; including detail and location of required interface connections, detail and location of base anchor bolt holes.

2.2.3 Adsorber Vessel and Underdrain drawing, including nozzle schedule and ASME Code information. (Manufacturer's Data Sheet available upon request after vessel fabrication is complete)

2.2.4 Bill of Materials for specialty items, any extra material that may be supplied with the system and Specifications for all equipment items.

2.2.5 List of recommended spare parts, identifying those spare parts that are available through Calgon Carbon.

2.3 Operating Manual Submittal

Prior to delivery and startup of the Adsorption System, six (6) copies of the Operation and Maintenance Manual will be provided. This manual will incorporate all necessary information from prior submittals. Operating section will include complete instructions on staging the adsorbers, backwashing the carbon bed, unloading spent carbon, loading fresh carbon and conditioning the new bed. The manual will also include identification of Calgon Carbon personnel for on-going technical support.

3. PROCESS DESCRIPTION

3.1 Carbon Adsorption

The Adsorption System utilizes granular activated carbon (GAC) for efficient removal of dissolved organic chemical compounds from the water or liquid requiring treatment. Adsorption is a physical process in which the compounds adhere to the surface of the carbon particle. The large surface area contained within the internal structure of the granular carbon particle provides the Carbon Adsorption System with a substantial capacity for the organic chemical compounds to be removed. The Adsorption System provides effective exposure of the contaminated water to the GAC contained in the system.

The Carbon Adsorption System consists of two process vessels (adsorbers) operated in series or parallel. Each adsorber will contain twenty thousand (20,000) pounds of GAC. Water is conveyed to the adsorption system from the source, provided sufficient pressure is available, or it can be collected and repumped.

Water will enter the lead (or both) adsorber(s) at the top and flow downward through the bed. No internal distributor is required, as the space above the bed and the characteristics of flow though packed beds is sufficient to distribute the flow across the bed area. An internal collection system at the bottom of the adsorber is provided to collect the treated water equally from the cross sectional area of the bed and retain the granular carbon in the bed. The same system is used to introduce backwash water evenly across the bed to allow backwashing without disrupting the vertical classification of the packed bed. In series operation, the effluent from the lead adsorber, or first stage, is then directed to the polish, or second stage, adsorber. The water then flows downward through the second bed and is discharged from the adsorption system and the effluent connection battery limit.

The adsorption system design provides for a contact time of 7.5 minutes per adsorber given a flow of 700 gpm through each adsorber vessel. The contact time is calculated on a "superficial" or "empty bed contact time" basis, which is the time it takes a volume of water to pass through the same volume that would be occupied by the carbon bed. The pressure drop across each adsorber is estimated to be 10 psig or less, based upon clean water and clean carbon bed.

3.2 Carbon Exchange

When the carbon in an adsorber becomes saturated, or "spent", with contaminants adsorbed from the water, this adsorber will be taken out of service to replace the spent GAC with fresh GAC. The adsorber requiring GAC replacement can be isolated from the process flow for the exchange procedure. The flow is directed to the other adsorber, now to become the lead adsorber in series operation, or is reduced in half to allow the remaining adsorber to continue operation at design conditions if the system is being operated in parallel.

The adsorber is pressurized to 15-30 psig with compressed air and the spent GAC is displaced into a receiving trailer or transfer tank as a water-carbon slurry. The bottom of the carbon bed is contained in a coned section, so nearly complete removal of the spent carbon is possible in a single transfer procedure. Fresh carbon is transferred as a water-carbon slurry from a delivery container utilizing air pressure or an eductor system.

After the adsorber has been refilled with fresh GAC, dearated and backwashed, it can be returned to service as the second stage in series operation, or as a parallel adsorber after which full system flow can be resumed.

The transfer operation is fully compatible with Calgon Carbon's transfer trailers. The transfer trailer is designed to contain and transport 20,000 pounds of either dry or wet (drained) GAC, which means that the content of each single adsorber is contained in a single trailer. Hose connections easily connect the trailer to the adsorbers, and the transfer is made with air pressure to minimize water generation. The exchange is conducted in a "closed loop" to minimize loss of material and exposure of spent carbon to workers or the site. Spent GAC returned to Calgon Carbon is thermally reactivated and all contaminants are thermally destroyed in the process.

In addition to the surfaces in contact with the GAC, the other vessel internal wetted surfaces under the cone section, (not in contact with GAC) are lined with a thin film vinyl ester coating to retard rust formation.

Following cleaning of the exterior, finish painting using an epoxy mastic coating system to a total dry film thickness of 6 mils in two applications is applied before rust can form. The two coat system is Sherwin Williams B58 Series consisting of a high solids, polyamine/bisphenol A epoxy formulation, which provides excellent resistance to condensation.

4.2 Underdrain Collection System

The cone section at the bottom of the carbon bed contains the underdrain collection system. The cone contains 80 nozzles to allow passage of water to the collection area below the cone and retain the GAC in the bed. The nozzles have been spaced to allow collection of the treated water from all zones of the cross sectional area. The nozzles also distribute backwash water at the bottom of the bed to evenly expand the bed without disrupting the classification of the GAC in the bed. The number of nozzles minimizes the face velocity at the nozzle, which if too high could cause either channeling at the nozzles or uneven backwash. The nozzles are constructed of polypropylene, and designed to withstand forward flow, backwash flow and movement of the GAC as it is discharged from the adsorber. With polypropylene nozzles, all bed internals are non-metallic.

4.3 Piping Network

A process piping network is provided for the pair of adsorbers that allows the following operations to be performed.

4.3.1 Treatment

Under normal operation, the full flow of up to 700 gpm per adsorber is accepted at the system battery limits and directed to the lead adsorber if operated in series. The interconnecting piping allows for either adsorber to be operated in the lead position, and the effluent from that adsorber to be directed to the second adsorber. The effluent from the second adsorber is directed to the battery limits as the system effluent.

For parallel operation, flow of up to 1400 gpm is provided to the system battery limit and directed to both adsorbers. The effluent from both adsorbers is then combined in the pipe network for a single system effluent connection. Piping network valves isolate the influent from the treated water.

4. EQUIPMENT DESCRIPTION

4.1 Adsorber Vessels

Adsorbers are 10 ft. diameter vertical cylindrical pressure vessels with a semi-elliptical top head. The adsorber is designed such that the GAC is contained in a bottom cone with 45 degree slope, so that the GAC can be easily and completely discharged when spent. The vessels are designed, constructed and stamped in accordance with the ASME Code, Section VIII for a design pressure rating of 125 psig at 150 degrees F. The vessel is equipped with a 20" round, flanged manway on the lower side for maintenance access. There is an additional 14"x18" elliptical, quick opening manway on the bottom of the vessel for access to the underside of the cone.

The adsorber is provided with 4" nozzles for GAC fill and discharge, 8" nozzles for water and backwash connections, and 2" nozzles for optional bed sample probe. The bed sample probes can be added to allow drawing water samples from the carbon bed above the collection system. Sample probes would only extend approximately 12 inches into the bed. All nozzle connections are flush on the inside of the shell and are provided with 150 pound flat face flanges for connections.

The capacity of the adsorber is designed to contain 20,000 pounds of granular activated carbon. and allow for approximately 30% expansion of the GAC bed for backwash.

The adsorber is constructed of carbon steel, has all welds and any other sharp edges ground smooth and all imperfections such as skip welds, delaminations, scabs, slivers and slag corrected to allow for effective surface preparation. All surfaces are degreased prior to surface preparation. The adsorber internal surface that will be lined is blasted to a white metal surface (SSPC-SP5) to provide an anchor pattern in the metal corresponding to a degree of profile of 4 mils. minimum. The exterior of the adsorber is sandblasted or power tool cleaned to the degree specified by SSPC-SP2-63.

The interior of the adsorber that is in contact with the GAC is lined in order to prevent corrosion that will occur when wet activated carbon is in contact with carbon steel. Immediately after sandblasting, the interior surface is lined with light gray Plasite 4110 Abrasion-Resistant Protective Coating in two multi-pass spray coatings per manufacturer's instructions to produce a nominal 35 mil dry film thickness. This is a lining consisting of vinyl ester resin and inert flake pigment which exhibits excellent chemical resistance to a wide range of water solutions, provides excellent abrasion resistance to the movement of GAC and meets requirements of the U>S Federal Register, Food and Drug Regulations Title 21, Chapter 1, Paragraph 175.300.

With the exception of GAC discharge piping, all piping is carbon steel piping, fabricated using ASTM A53, Grade B carbon steel, rated for 150 psig @ 500 DEG F. For 2" and larger, piping is schedule 40 and provided with 150 pound ANSI B16.5. ASTM A105 forged steel slip-on or weld neck flanges. All piping welds are made in accordance with ANSI B31.3 by welders qualified under ASME Section IX.

Pipe fittings including tees, will be Class 125 pound flanged cast iron per ASTM A126, Class B. Piping less than 2" in diameter will be Schedule 80, threaded. Gaskets for the steel piping are red rubber. (Manway gaskets are EPR type rubber)

The steel piping network will contain rubber expansion joints to allow for installation and operation without alignment problems or creating undue stress on piping between the adsorber vessels and the piping network. Expansion joints are double arch type, with 4 way movement and allowance for 30 DEG angular misalignment. Expansion joint is constructed of molded neoprene (wetted surface), reinforced with multiple plies of nylon, and is rated up to 225 psig at 170 DEG F.

Carbon discharge piping up to the discharge valve must be corrosion resistant as it is in contact with wet activated carbon, and therefore is polypropylene lined steel pipe rated at 150 psig to 225 DEG F. The steel pipe base is Schedule 40, ASTM A53 steel pipe with 125 pound ASTM A126, Class B cast iron flanges and fittings.

The exterior of the piping is power tool cleaned to the degree specified by SSPC-SP3-63 with a finish exterior painting of an epoxy mastic coating system. The two coat system results in a total 6 mil dry film thickness. Exterior paint is Sherwin Williams B58 Series coating, consisting of high solids, polyamine/bisphenol A epoxy formulation.

4.5 Process and Utility Valves

The process, backwash and utility piping, excluding GAC fill and discharge piping shall be equipped with butterfly valves for tight shut-off, isolation and flow control purposes. Butterfly valves are cast iron, one piece wafer type body with a bronze disc and stainless steel one piece through shaft, designed to mate with Class 125 ANSI flanges. Valves are rated for 200 psig in closed position at 180 DEG F, and meet or exceed all of the design strength, testing and performance requirements of AWWA Specification C-504 (laying length may vary).

4.3.2 Carbon Exchange

During carbon exchange, the adsorber being exchanged is isolated from the treatment process with valving in the piping network. The water flow is then reduced by 50% and directed solely to the other adsorber if the system is being operated in parallel, or directed completely to the second stage adsorber (which will be the lead adsorber after exchange is completed) in series operation.

For carbon discharge, the adsorber is isolated, pressurized with air, after which the GAC is discharged through the outlet piping. For fill, the adsorber vent is opened and GAC charged through the carbon fill line. After filling, the GAC bed is classified with a brief backwash procedure.

4.3.3 Adsorber Backwash

The piping network enables the adsorber to be backwashed should an unacceptable pressure drop develop across the carbon bed due to the introduction of filterable suspended solids to the system. The adsorber being backwashed is isolated from the process flow as for carbon exchange, except for series flow. when the lead bed is backwashed the process flow should be stopped. Directing process flow to the polish bed prematurely will disrupt the adsorption characteristics and may cause premature breakthrough of contaminants to the system effluent.

An uncontaminated source of backwash water should be provided to the backwash water connection at the system battery limits. Backwash water is introduced at the bottom of the GAC bed at a rate of approximately 1000 gpm to effect a 30% bed expansion. Backwash water exits the top of the bed and is directed to the system battery limits at the "drain" connection; a single connection for backwash, vent and other drain sources.

4.4 Process and Utility Piping

The process and utility piping on the adsorption system includes influent water and backwash discharge to the top of the adsorber (8"), treated water and backwash source water to the bottom of the adsorber (8"), GAC fill and discharge lines (4"). Connections are provided on these primary lines for venting, pressure relief, utility water and air, sample and flush connections, and pressure instrumentation.

Valves on the GAC fill and discharge need to withstand the corrosion and abrasion caused by the movement of wet GAC, and therefore are 316 stainless steel full bore ball valves with TFE seats and seals. Valves are wrench operated, and have 150 pound ANSI flanged ends.

Valving for small lines, including flush connections, sample points, pressure gauges and compressed air connections are bronze, forged brass or barstock brass body regular port ball valves, rated for 500 psig at 100 DEG F.

4.6 Piping System Accessories

4.6.1 Transfer Hose Connectors

The GAC piping is fitted with hose connectors, such that GAC transfer to and from the adsorbers can be facilitated with transfer hoses. Connectors are 4" Quick Disconnect Adaptors constructed of aluminum.

4.6.2 Flush and Air Connections

Two flush connections are provided on the GAC fill line on each side of the valve, one flush connection on the discharge line downstream of the valve and an air connection is provided on the adsorber influent line. Connections are welded into the steel pipe, or provided in polyproplylene "spacers", and shall consist of a short section of 3/4" pipe, a 3/4" ball valve as specified and a 3/4" quick disconnect adaptor for hose connection.

4.6.3 Pressure Relief

The system vent line (connected to the adsorber influent line) is equipped with a rupture disk for emergency pressure relief. The rupture disk is constructed of impervious graphite and is designed to relieve pressure at 94 psig +/- 5 percent, which is the recommended operating pressure for the system.

4.7 Instrumentation

4.7.1 Pressure Gauges

The adsorber piping network is equipped with pressure gauges to indicate the pressure of water entering and exiting each adsorber to provide information on pressure drops across each adsorber and the system. The pressure indicating gauges are 4 1/2" face diameter size with a stainless steel bourdon tube in a glycerin filled housing. The gauge reads 0-150 psig with an accuracy of 1% of full range.

4.7.2 Differential Pressure Switch

The Adsorption System is equipped with an indicating differential pressure switch to measure both the pressure drop across the adsorber and also across the cone at the bottom of the adsorber. The switches are connected to taps on the influent and effluent piping. The measuring element is diaphragm operated, with the differential pressure shown on a 4" diameter dial calibrated for 20-0-20 psi. The switch is provided with contacts for 10 amps @ 115 volts AC for remote indication. The switch is a Dwyer Instruments Capsu-photohelic Model 43000-B or equal. In order to protect the integrity of the cone section, it is the responsibility of the site operations to assure that the differential pressure switch is properly monitored or alarmed.

4.8 Steel Support Skid (OPTIONAL)

The Adsorption System is provided with a steel skid for mounting of the adsorber vessels and the piping network (not for transport of the system). The skid provides a pre-engineered support structure for convenient installation of the vessels and piping. The skid consists of two lengthwise A36 steel beams (W12X26, minimum) and all necessary cross bracing. Slots are provided in the channels for installation on a foundation if required. The steel skid is finished painted similar to the exterior of the carbon steel piping as described in Section 4.4.

4.9 Sample Probes (OPTIONAL)

The adsorption system may be provided with two sample probes per adsorber. Each sample probe is constructed of stainless steel. extends approximately one foot into the carbon bed and is equipped with a wedge wire screen end section to collect the water sample from the bed. The water exits the adsorber, and is directed by a 3/4" steel pipe to a sample valve at operating level.

5. GRANULAR ACTIVATED CARBON

5.1 General

Twenty thousand (20,000) pounds of Granular Activated Carbon will be provided nad installed within each adsorber vessel.

5.2 GAC Specification

The activated carbon will be virgin grade material, manufactured in a domestic (U.S.) facility from domestic mined bituminous coal. The activated carbon will be Calgon Carbon Type Filtrasorb 300 and conform to the following specifications:

Iodine Number (minimum)	900
Abrasion Number (minimum)	75
Effective Size	0.8 - 1.0 mm
Screen Analysis	
on 8 mesh (maximum %)	15
through 30 mesh (maximum %)	4
Water Soluble Ash (maximum %)	1
Total Ash (maximum %)	10
Moisture, as packed (maximum %)	2
Total Phosphate, as PO4 (maximum %)	1

The delivered granular activated carbon will be accompanied by an analysis sheet upon request.

6. SERVICES

6.1 Adsorption System Installation

Calgon Carbon Corporation will make all necessary arrangements for and will provide supervision for the installation of the adsorption system including initial fill of GAC. Calgon Carbon's Project Manager will coordinate all necessary activities with the site personnel, including scheduling, site safety or other procedures, authorization of construction personnel and site responsibilities (services not provided by Calgon Carbon Corporation but necessary for the installation and start-up of the adsorption system.

6.2 Operator Training and Start-Up Assistance

Calgon Carbon Corporation will provide the services of qualified company personnel who will be responsible for pre-startup inspection of the adsorption system, site operator training (formal and informal) and assistance to the site during system start-up. Two days of field service are provided for these activities, after which more technical assistance can be contracted for at per diem rates.

Battery limits for the adsorption system are defined as the influent, effluent, backwash and vent connection flanges, all hose connections and the (optional) support skid. All equipment within these limits are provided by Calgon Carbon.

2 Work Included

The Scope of Work includes the furnishing of all equipment, materials and services to comprise a complete adsorption system:

2.1 Two 12 ft dia. downflow adsorbers including a water collection system (underdrain). Adsorbers are 125 psig ASME code pressure vessels, with a corrosion resistant lining where GAC contacts the steel. The internal lining is a 35 mil nominal dry film thickness vinyl ester lining, accepted for potable water treatment. Adsorbers include a PVC (polyvinyl chloride) solid pipe header underdrain with polypropylene slotted nozzles. The number of nozzles is equal to the total number of square feet in the cross sectional area, arranged by the Supplier for optimum collection of treated water as decribed in the specification.

2.2 8 Inch dia. carbon steel pipe with cast iron fittings for influent, effluent and backwash piping on the adsorption system. Piping allows placement of either adsorber in the lead position in a series arrangement, or allows both adsorbers to be operated as a single stage or in parallel. Valving allows either adsorber to be isolated for carbon exchange or backwash, while maintaining operation through the other adsorber if viable.

2.3 Independent GAC fill and discharge piping, including corrosion resistant valves and hose connections.

2.4 Vent and safety relief piping, flush water connections, motive air connections for GAC transfers, pressure gauges and sample points.

2.5 Delivery and installation of the Adsorption System on foundation provided by others, if required.

2.6 Delivery and installation of 20,000 pounds of Granular Activated Carbon, as specified, per adsorber.

2.7 One complete set of technical specifications and six Operation and Maintenance Manuals.

2.8 Training of site operators by qualified Calgon Carbon personnel.

3 Operating Manual Submittal

Prior to delivery and startup of the Adsorption System, six (6) copies of the Operation and Maintenance Manual will be provided. This manual will incorporate all necessary information from prior submittals. Operating section will include complete instructions on staging the adsorbers, backwashing the carbon bed, unloading spent carbon, loading fresh carbon and conditioning the new bed. The manual will also include identification Of Calgon Carbon personnel for on-going technical support.

EQUIPMENT DESCRIPTION

1 Adsorber Vessels

Adsorbers are 12 ft. diameter vertical cylindrical pressure vessels with flanged and dished heads. The vessels are designed, constructed and stamped in accordance with the ASME Code, Section VIII for a design pressure rating of 125 psig at 150 degrees F. The vessel is equipped with a 20" round, flanged manway on the lower side for maintenance access.

The adsorber is provided with 4" nozzles for GAC fill and discharge, 8" nozzles for water and backwash connections, and two 2" nozzles for optional bed sample probes. The bed sample probes can be added to allow drawing water samples from the carbon bed above the collection system. Sample probes would only extend approximately 12 inches into the bed. All nozzle connections are flush on the inside of the shell and are provided with 150 pound flat face flanges for connections.

The capacity of the adsorber is designed to contain 20,000 pounds of granular activated carbon, and allow for approximately 35% expansion of the GAC bed for backwash.

The adsorber is constructed of carbon steel, has all welds and any other sharp edges ground smooth and all imperfections such as skip welds, delaminations, scabs, slivers and slag corrected to allow for effective surface preparation. All surfaces are degreased prior to surface preparation. The adsorber internal surface that will be lined is blasted to a white metal surface (SSPC-SP5) to provide an anchor pattern in the metal corresponding to a degree of profile of 4 mils, minimum. The exterior of the adsorber is sandblasted or power tool cleaned to the degree specified by SSPC-SP2-63.

The interior of the adsorber that is in contact with the GAC is lined in order to prevent corrosion that will occur when wet activated carbon is in contact with carbon steel.

Immediately after sandblasting, the interior surface is lined with light gray Plasite 4110 Abrasion-Resistant Protective Coating in two multi-pass spray coatings per manufacturer's instructions to produce a 35 to 40 mil dry film thickness. The internal lining consists of vinyl ester resin and inert flake pigment which exhibits excellent chemical resistance to a wide range of water solutions, and provides excellent abrasion resistance to the movement of GAC.

Following cleaning of the exterior, finish painting using an epoxy mastic coating system to a total dry film thickness of 6 mils in two applications is applied before rust can form. The two coat system is Sherwin Williams B58 Series consisting of a high solids, polyamine/bisphenol A epoxy formulation, which provides excellent resistance to condensation.

2 Underdrain Collection System

The section at the bottom of the carbon bed contains the underdrain collection system. The underdrain collection system consists of solid PVC pipe header system with a minimum of 113 polypropylene slotted nozzles, arranged across the cross-sectional area and no further than 12 inches from the bottom head for optimum use of the carbon. The nozzles also distribute backwash water at the bottom of the bed to evenly expand the bed without disrupting the classification of the GAC in the bed. The number of nozzles minimizes the face velocity at the nozzle to 1 ft/sec at maximum design flow. If this velocity is too high, either channeling at the nozzles or uneven backwash could occur. The nozzles are constructed of polypropylene, and designed to withstand forward flow, backwash flow and movement of the GAC as it is discharged from the adsorber. With polypropylene nozzles, all bed internals are non-metallic.

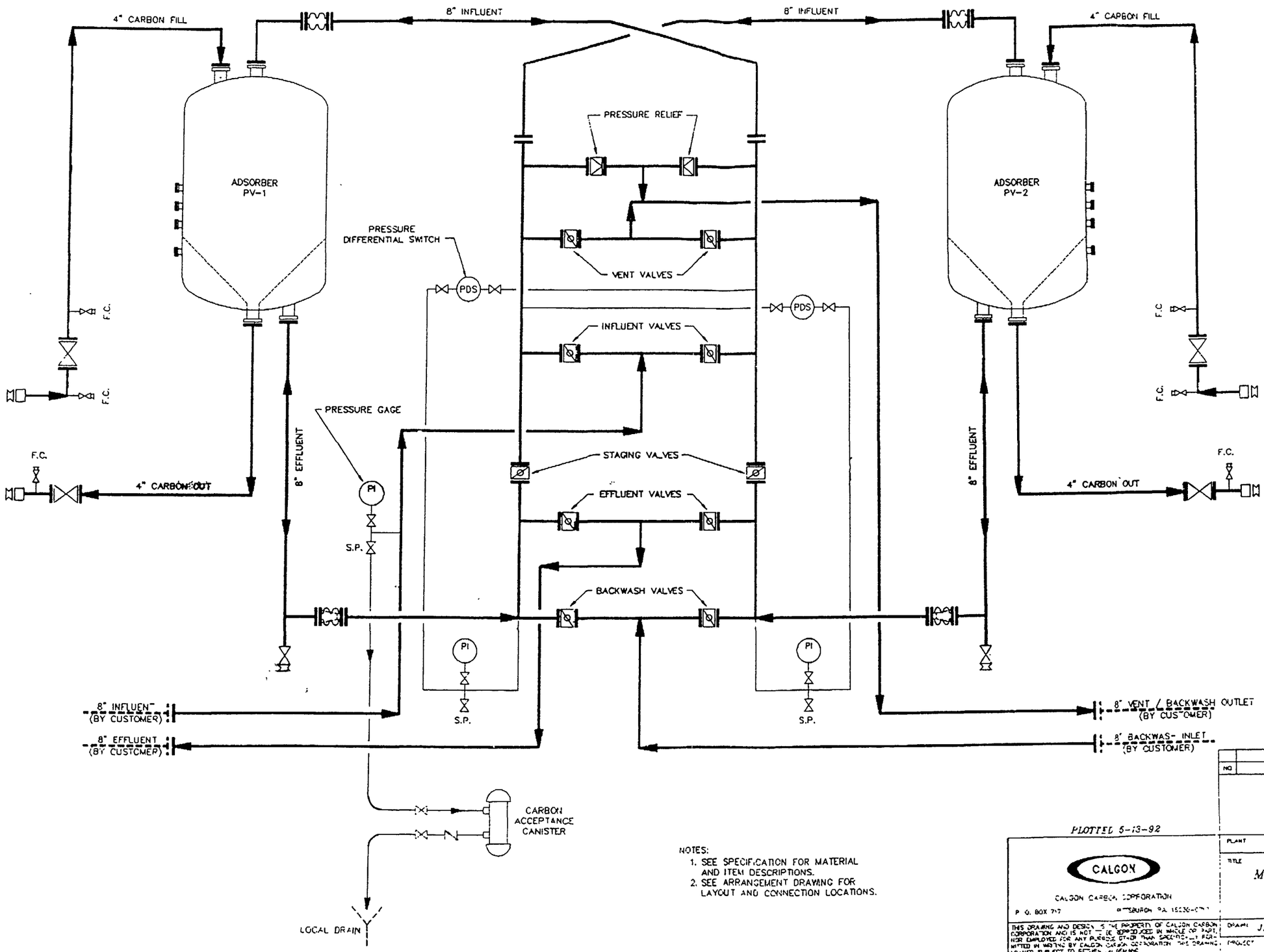
3 Piping Network

A process piping network is provided for the pair of adsorbers that allows the following operations to be performed.

3.1 Treatment

Under normal operation, the full flow of up to 700 gpm is accepted at the system battery limits and directed to the lead adsorber if operated in series. The interconnecting piping allows for either adsorber to be operated in the lead position, and the effluent from that adsorber to be directed to the second adsorber. The effluent from the second adsorber is directed to the battery limits as the system effluent.

For parallel operation, flow of up to 1400 gpm is provided to



NOTES:
1. SEE SPECIFICATION FOR MATERIAL AND ITEM DESCRIPTIONS.
2. SEE ARRANGEMENT DRAWING FOR LAYOUT AND CONNECTION LOCATIONS.

NO	REVISION	BY	DATE	PLN

PLOTTED 5-13-92

CALGON

CALGON CARBON CORPORATION
P. O. BOX 717 PITTSBURGH, PA. 15230-0717

PLANT

TITLE
MODULAR ADSORBER SYSTEM
8" BACKWASH
FLOW DIAGRAM

DRAWN JFS	CHECKED	APPROVED	SCALE
PROJECT	DRAWING NO	90-92-1606	